APPENDIX F
EFH Assessment

ESSENTIAL FISH HABITAT ASSESSMENT

FOR THE
MIAMI HARBOR
GENERAL REEVALUATION REPORT STUDY
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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1.0 INTRODUCTION

The Port of Miami (Port) requested that the U.S. Army Corps of Engineers (USACE) study the feasibility of widening and deepening most of the major channels and basins within the Port. Two major improvement goals were identified to accommodate larger vessels: 1) widen the Entrance Channel, Fisher Island Turning Basin and Fisherman's Channel; and 2) deepen the Entrance Channel, Government Cut and Fisher Island Turning Basin. A number of alternatives were originally considered, but during in an effort to reduce impacts to the natural environment, many were eliminated from further analysis. Three alternatives are being analyzed (two action alternatives and the No-Action alternative) in the Draft Environmental Impact Statement. The Recommended Plan (Alternative 2) includes components that would widen and deepen the Entrance Channel, deepen Government Cut, deepen and widen Fisher Island Turning Basin, relocate the west end of the Main Channel (no dredging involved), and deepen and widen Fisherman's Channel and the Lummus Island Turning Basin. Disposal of dredged materials would occur at up to four disposal sites [seagrass mitigation area, offshore permitted artificial reef areas, approved upland disposal site or the Miami Offshore Dredged Material Disposal Site (ODMDS)]. The Recommended Plan would impact 0.2 acre of seagrass habitat within the existing channel, 6.1 acres of seagrass habitat outside of the existing channel, 28.7 acres of low relief hardbottom/reef habitat, 20.7 acres of high relief hard/bottom/reef habitat, 123.5 acres of rock/rubble habitat, and 236.4 acres of unvegetated bottom habitat. Impacts to fish species may occur due to loss of habitat and blasting activities associated with project construction activities. The Recommended Plan would cause temporary increases in turbidity; however, these levels would not exceed permitted variance levels outside the mixing zone. Mitigation proposed for seagrass impacts would include restoration of previously dredged borrow areas within northern Biscayne Bay while mitigation proposed to offset impacts to high and low relief reef habitat would include creation of artificial reefs within permitted offshore artificial reef sites.

2.0 PROJECT DESCRIPTION

2.1 Background

The Port is a 660-acre island facility created from two spoil islands, Dodge Island and Lummus Island. The western end is Dodge Island, and the eastern end is Lummus Island. The Port is connected to the Miami mainland by two bridges, a 65-foot high, fixed span vehicular bridge, and a road and a rail bridge linking to the Florida East Coast Railroad Company's main line track (USACE 2002).

The Port is a "clean port," the designation of a seaport that does not handle bulk cargoes or potentially dangerous or hazardous cargoes such as fuel oil. The Port handles only palletized, roll-on/roll-off (RO/RO), and containerized cargo. In addition to cargo traffic, the Port is also a major cruise ship port. It is the year-round homeport of the largest cruise ship in the world, the VOYAGER OF THE SEAS. As reported in the 1999 Port of Miami Master Development Plan (April 30,1999), the Port consists of 518 acres of actual landmass. Of the 518 acres, 372.5 acres (71.9 percent) is devoted to cargo operations, mainly on Lummus Island, and 52 acres (10.0 percent) is devoted to cruise operations on Dodge Island. The Port also leases 34 acres from the Florida East Coast Railway at its Buena Vista yard, which is located approximately 2.5 miles northwest of the Port. This leased property is used as an intermodal container marshaling and storage area for transshipments.

The Port is a landlord port, owned by Miami-Dade County, Florida and managed by the Miami-Dade County Seaport Department. The Port Director reports to the County Manager. Facilities are leased to Port users and operators. There are three principal terminal operators at the Port: Seaboard Marine, the Port of Miami Terminal Operating Company (POMTOC), and Universal Maritime/Maersk. Seaboard Marine's container terminal and storage areas are located along the southern portion of Dodge Island and the southwest corner of Lummus Island. POMTOC's container terminal is located exclusively on Lummus Island, as is Universal Maritime/Maersk's (northeastern portion).

Currently there are three Panamax and seven Post-Panamax gantry cranes. Two additional super-Post-Panamax gantry cranes are scheduled to arrive in October 2002. Panamax, Post-Panamax, and Super-Post-Panamax gantry cranes are designed to reach across 13 containers (each approximately 8 feet wide), 17 containers, and 22 containers, respectively.

In addition to gantry cranes, the Port's cargo handling equipment includes forklifts, toploaders, and mobile truck cranes including three Mi-Jack 850-P Rubber Tire Gantries (RTGs), which allow containers to be stacked 6-wide and 4-high.

There are eleven passenger terminals that accommodated 3.3 million passengers in fiscal year 2000. The Port's passenger terminals are designated Terminals 1 through 5, Terminal 6/7, Terminal 8/9, Terminal 10, and Terminal 12.

As identified in the Port's 1999 Master Plan, approximately 47.5 acres of the Port's land area is utilized by support facilities: parking, 17.0 acres; circulation and open space, 10.5 acres; office – Federal Government, 8.5 acres; recreation, 7.5 acres; office-miscellaneous and office-Seaport Department, 1.7 acres.

CSX Transportation, Inc. serves the Port. The Miami-Dade County Seaport Department owns 2.1 miles of trackage at the Port on Dodge Island, which consists of a main line track extending the length of the island and a four-track, closed-end intermodal rail yard. The main track on Dodge Island connects with the Florida East Coast Railway via a rail bridge. A connection with CSX Transportation, Inc. is effected through an interchange in the west part of the City of Miami. Moreover, the Port is less than one mile from major highways: Interstate 95 and Federal Route 1 via Interstate 395, and Interstate 75 via Dolphin and Palmetto Expressways.

Even though the Port is considered a "clean port" there is a private petroleum facility at Fisher Island. This facility receives Number 6 fuel oil and diesel fuel by tankers and barge (integrated tug and barge units). The fuel is used solely for bunkering the Port's cargo and cruise ships, which are bunkered at the berth by tank truck or by bunkering barge. This facility has an 800-foot long berth with a depth of 36 feet and 12 storage tanks having a total capacity of 667,190 barrels.

As reported in the USACE Port Series No. 16 document (revised 1999), within Metropolitan Miami-Dade County 12 companies operate warehouses having a total of over 1,000,000 square feet of dry storage space and over 6,000,000 cubic feet of cooler and freezer space. All except three of the warehouses have railroad connections, and each is accessible to arterial highways.

Anchorage for deep-draft cargo vessels lies north of the Entrance Channel to the Port of Miami. There are no bridges crossing the shipping channels for Dodge and Lummus Islands.

2.2 Description of the Alternatives

2.2.1 No-Action Alternative

The Port would continue operations under existing conditions. Currently, there are two options available for moving cargo to terminal facilities in those areas. One is to use vessels with drafts that enable access over existing depths and widths. The second is to use another terminal at the Port and move the cargo to the facilities (USACE 1996). Current dimensions of the channels and turning basins are described below in Table 1.

Table 1 Current Channel and Turning Basin Dimensions

Entrance Channel	500 feet wide and 44-foot depth
Government Cut	500 feet wide and 42-foot depth
Fisher Island Turning Basin	Triangular-shaped bottom with a 42-foot depth
Main Channel	400 feet wide and 36-foot depth
Fisherman's Channel and Lummus Island Turning Basin	The channel is 400 feet wide and 42-foot depth. The turning basin has a turning diameter of 1,500 feet and 42-foot depth.
Dodge Island Cut and Turning Basin	400 feet wide and 34-foot depth

2.2.2 Alternative 1

Alternative 1 consists of six components that are designed to improve Port transit for the existing and future fleets.

Component 1C — Flare the existing 500-foot wide Entrance Channel to provide an 800-foot wide entrance at Buoy #1. The widener would extend from the beginning of the Entrance Channel approximately 150 feet parallel to both sides of the existing Entrance Channel for approximately 900 feet before tapering back to the existing channel edge over a total distance of approximately 2,000 feet. Deepen the Entrance Channel and proposed widener along Government Cut from an existing depth of 44 feet to a depth of 52 feet.

Component 2A — Widen the southern intersection of Government Cut near Buoy #15. The length of the widener would be approximately 700 feet with a maximum width of approximately 75 feet. Deepen from existing project depth of 42 feet to 50 feet.

Component 3B — Extend the existing Fisher Island Turning Basin 300 feet to the north of the existing channel edge near the west end of Government Cut. Widen the basin to 1,500 feet by 1,200 feet. Deepen channel below existing project depths of 42 feet to 50 feet.

Component 4 — Relocate the west end of the Main Channel approximately 250 feet to the south between channel miles 2 and 3 over a two- or three-degree transition to the existing cruise ship turning basin. No dredging is expected for this component since existing depths allow for continuation of the authorized depth of 36 feet.

Component 5A — Increase the width of the Fisherman's Channel approximately 100 feet to the south of the existing channel. This component also includes a 1,500-foot diameter turning basin, which would reduce the existing size of the Lummus Island Turning Basin. This widener at the northwest corner of the turning basin eases the turn to the Dodge Island Cut. Deepen channel from the current authorized depth of 42 feet to 50 feet along the proposed widener of Fisherman's Channel from Station 0+00 to the Lummus Island Turning Basin.

Component 6 — Deepen Dodge Island Cut and the proposed 1,200-foot turning basin from 32 and 34 feet to 36 feet. Relocate the western end of the Dodge Island Cut to accommodate proposed port expansion.

2.2.3 Alternative 2

Alternative 2 consists of five components that are designed to Port transit for the existing and future fleets.

Component 1C — Flare the existing 500-foot wide Entrance Channel to provide an 800-foot wide entrance at Buoy #1. The widener would extend from the beginning of the Entrance Channel approximately 150 feet parallel to both sides of the existing Entrance Channel for approximately 900 feet before tapering back to the existing channel edge over a total distance of approximately 2,000 feet. Deepen the Entrance Channel and proposed widener along Government Cut from an existing depth of 44 feet to a depth of 52 feet.

Component 2A — Widen the southern intersection of Government Cut near Buoy #15. The length of the widener would be approximately 700 feet with a maximum width of approximately 75 feet. Deepen from existing project depth of 42 feet to 50 feet.

Component 3B — Extend the existing Fisher Island Turning Basin 300 feet to the north of the existing channel edge near the west end of Government Cut. Widen the basin to 1,500 feet by 1,200 feet. Deepen channel below existing project depths of 42 feet to 50 feet.

Component 4	Relocate the west end of the Main Channel approximately 250 feet to the south between channel miles 2 and 3 over a two- or three-degree transition to the existing cruise ship turning basin. No dredging is expected for this component since existing depths allow for continuation of the authorized depth of 36 feet.
Component 5A	Increase the width of the Fisherman's Channel approximately 100 feet to the south of the existing channel. This component also includes a 1,500-foot diameter turning basin, which would reduce the existing size of the Lummus Island Turning Basin. This widener at the northwest corner of the turning basin eases the turn to the Dodge Island Cut. Deepen channel from the current authorized depth of 42 feet to 50 feet along the proposed widener of Fisherman's Channel from Station 0+00 to the Lummus Island Turning Basin.

2.3 Alternatives Eliminated from Detailed Evaluation

Original components contained in the alternatives considered for this project have been revised several times to minimize cost and impacts to the environment. Previous versions of the components are described below and are listed in Table 2.

Component 1

Four different versions of Component 1 received consideration during the plan formulation process. Receipt of the Baseline Environmental Resource Survey and ship simulation results allowed additional evaluations of the Entrance Channel alternatives based on the location of environmental resources and ship transits.

Further discussions with the Pilots resulted in two additional modifications of Component 1, which completely avoids one reef area (Component 1C). Component 1A avoided one reef location, but did not provide sufficient widening in the area where currents impact vessel transits. Component 1B avoided both reef areas, but did not provide widening in the area of the difficult north and south currents.

Component 2

Two different orientations for the widener received consideration, which included Component 2 and Component 2A. The first recommended by the Pilots (Component 2) extended from the southern edge of Fisherman's Channel parallel to Government Cut between Buoys #13 and #15 over a distance of approximately 2,400 feet.

Ship simulation testing of Component 2 indicated the Pilots did not use the widener during any of the simulation exercises. Subsequent discussions on May 16, 2001 with the Pilots resulted in a reduction of the widener from 2,400 to 700 feet. During a later simulation of the revised Component 2A at the pilot station, a ship grounded at the location of the proposed widener.

Table 2 Avoidance and Minimization of Direct Impacts of the Preliminary Design Plan and Recommended Plan

Habitat Type	Component													
	1[1]	**1C**[2]	**2**[1]	**2A**[2]	**3**[1]	**3B**[2]	**4**[2]	**5**[1]	**5A**[2]	**6**[1]	**6A**[3]		**Previous Total**	**Revised Total**
Seagrass beds[4] (ac)	0	0	0	0	**0.7**	0	0	**1.7**	**0.2**	**22.8**	NA		**25.2**	**0.2**
Low relief hardbottom/reef (ac)	**35.1**	**28.7**	0	0	0	0	0	0	0	0	NA		**35.1**	**28.7**
High relief hardbottom/reef (ac)	**21.1**	**20.7**	0	0	0	0	0	0	0	0	NA		**21.1**	**20.7**
Rock/rubble w/ live bottom (ac)	**51.7**	**51.7**	0	0	0	0	0	0	0	0	NA		**51.7**	**51.7**
Rock/rubble w/ algae/sponges (ac)	**41.3**	**41.3**	**3.9**	**0.6**	**5.4**	**26.1**	0	**59.4**	**3.8**	0	NA		**136.2**	**71.8**
Unvegetated (ac)	**70.1**	**68.2**	**1.7**	**0**	**9.4**	**24.4**	**0**	**166.8**	**143.8**	**55.4**	**NA**		**333.5**	**236.4**
Total Project Footprint (ac)	**227.8**	**210.6**	**5.6**	**0.6**	**15.5**	**50.5**	**0**	**228.9**	**147.8**	**78.2**	**0**		**612.3**	**409.5**

[1]Original Proposed Impacts
[2]Recommended Plan Impacts
[3]Not Evaluated
[4]Does not include side slope equilibration impacts

Component 3

Component 3 proposed a 1,600-foot diameter turning basin. Following review of the Environmental Baseline Survey and ship simulation tests, Component 3A was identified which reduced the turning basin to a turning notch of approximately 1,500 by 1,450 feet. Since ship simulation testing indicated the Pilots did not use the northernmost section of Component 3, Component 3A was identified since it avoided impacts to most to the seagrass beds to the north.

Later discussions on May 16, 2001 resulted in the Pilots' proposal to completely avoid the seagrass area to the north by truncating the northeast section of the turning basin (Component 3B).

Component 4

No alternative design was considered for Component 4.

Component 5

During the ship simulation exercise, Component 5 provided additional room for vessels passing berthed ships along the container terminals. The Pilots used the additional width during almost every proposed condition test in the Fisherman's Channel.

Component 5A resulted from coordination with Fisher Island's engineering representatives to improve clearance between the proposed widener and a proposed new bulkhead in that area.

Component 6

Component 6 includes deepening of Dodge Island Cut and the proposed 1200-foot turning basin from 32 and 34 feet to 36 feet. It also involves relocating the western end of the Dodge Island Cut to accommodate proposed Port expansion.

Component 6A proposed widening about 1,200 feet of the Dodge Island Cut an additional 50 feet to the south as a result of ship simulation testing. During the ship simulation testing a number of ships left the south side of the channel segment between Lummus Island Turing Basin and Dodge Island Turning Basin. The Engineering Research and Development Center (Waterways Experiment Station) of the USACE recommended Component 6 on the condition that the southern edge of that segment is widened 50 feet, which resulted in Component 6A.

2.4 Recommended Plan

The Recommended Plan consists of five components that are designed to improve Port transit for the existing and future fleets.

Component 1C	Flare the existing 500-foot wide Entrance Channel to provide an 800-foot wide entrance at Buoy #1. The widener would extend from the beginning of the Entrance Channel approximately 150 feet parallel to both sides of the existing Entrance Channel for approximately 900 feet before tapering back to the existing channel edge over a total distance of approximately 2,000 feet. Deepen the Entrance Channel and proposed widener along Government Cut from an existing depth of 44 feet in one-foot increments to a depth of 52 feet.
Component 2A	Widen the southern intersection of Government Cut and Fisherman's Channel at Buoy #15. The length of the widener would be approximately 700 feet with a maximum width of approximately 75 feet. Deepen from existing project depth of 42 feet to 50 feet.
Component 3B	Extend the existing Fisher Island Turning Basin 300 feet to the north of the existing channel edge near the west end of Government Cut. This would widen the basin to 1,500 feet by 1,200. Deepen at one-foot increments below existing depths of 42 feet to 50 feet.
Component 4	Relocate the west end of the Main Channel approximately 250 feet to the south between channel miles 2 and 3 over a two- or three-degree transition to the existing cruise ship turning basin. No dredging is expected for this component since existing depths allow for continuation of the authorized depth of 36 feet.
Component 5A	Increase the width of the Fisherman's Channel approximately 100 feet to the south of the existing channel. This component also includes a 1,500-foot diameter turning basin, which would reduce the existing size of the Lummus Island Turning Basin. This widener at the northwest corner of the turning basin would ease the turn to the Dodge Island Cut. Deepen at one-foot increments from the existing 42-foot depth to 50 feet along the proposed widened Government Cut channel from Station 0+00 to Station 42+00.

2.5 Comparison of Alternatives

The following table (Table 3) provides a comparison of the No-Action Alternative and the Recommended Plan with regard to costs and potential impacts to natural resources and human environment. A more thorough analysis of potential impacts is included in Section 4.0, Environmental Consequences.

Table 3 Comparisons of Alternatives

Resource	No-Action Alternative	Alternative 1	Alternative 2 (Recommended Plan)
Coastal Environment	No significant impact.	No significant impact.	No significant impact.
Geology and Sediments	Additional vessel groundings may impact geological formations within the Biscayne Bay.	Additional sediment or material removal would occur.	Sediment or material removal would occur.
Water Quality	Additional vessel groundings may impact water quality.	Temporary increases in turbidity during dredging events may cause increased turbidity at the point of discharge from the disposal sites.	Temporary increases in turbidity during dredging events may cause increased turbidity at the point of discharge from the disposal sites.
Seagrass Communities	Additional vessel groundings may impact seagrass communities.	Significant direct impacts would include the removal of seagrass habitat. Indirect impacts to seagrass would occur through side slope equilibration.	Direct impacts would include the removal of seagrass habitat. Indirect impacts to seagrass would occur through side slope equilibration.
Hardbottom and Reef Communities	Additional vessel groundings may impact hardbottom and reef communities.	Widening and deepening would result in both direct and indirect impacts to hardbottom and reef communities within the Entrance Channel.	Widening and deepening would result in both direct and indirect impacts to hardbottom and reef communities within the Entrance Channel.
Rock/ Rubble Communities	Additional vessel groundings may impact rock rubble communities.	Proposed impacts to rock/rubble habitats are principally in areas that have already been dredged.	Proposed impacts to rock/rubble habitats are principally in areas that have already been dredged.
Unvegetated Bottom	Additional vessel groundings may impact unvegetated bottom communities.	Direct impacts to unvegetated bottom communities would include the impacts to both benthic epifauna and infauna but other direct effects and indirect effects would differ based on the general location of the impacts.	Direct impacts to unvegetated bottom communities would include the impacts to both benthic epifauna and infauna but other direct effects and indirect effects would differ based on the general location of the impacts.

Resource	No-Action Alternative	Alternative 1	Alternative 2 (Recommended Plan)
Essential Fish Habitat (EFH)	Additional vessel groundings may impact EFH.	EFH would be impacted.	EFH would be impacted.
Protected Species	Additional vessel groundings may impact protected species.	Potential impacts due to blasting and loss of habitat may occur during dredging and construction activities.	Potential impacts due to blasting and loss of habitat may occur during dredging and construction activities.
Other Areas of Special Concern	Navigational difficulties may impact Areas of Special Concern.	No significant impacts.	No significant impacts.
Air Quality	No significant impact.	Short-term impacts from dredge emissions and other construction equipment would not significantly impact air quality.	Short-term impacts from dredge emissions and other construction equipment would not significantly impact air quality.
Noise	No significant impact.	None of the project components are expected to have a significant impact to noise levels.	None of the project components are expected to have a significant impact to noise levels.
Utilities	No significant impact.	Four utility crossings would be impacted.	Four utility crossings would be impacted.
Hazardous, Toxic, and Radioactive Waste	No significant impact.	No significant impacts to HTRW within the project area would occur.	No significant impacts to HTRW within the project area would occur.
Economic Factors	Significant loss of cargo business would occur at the Port due to the inability to handle new industry standard deep draft cargo vessels.	Cargo business would be retained and may increase.	Cargo business would be retained and may increase.
Land Use	No significant impacts.	No significant impacts.	No significant impacts
Recreation	No significant impacts.	No significant impacts.	No significant impacts.
Aesthetic Resources	No significant impacts.	No significant impacts.	No significant impacts.
Cultural Resources	No significant impacts.	No significant impacts.	No significant impacts.

3.0 ESSENTIAL FISH HABITAT DESIGNATION

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976 and the 1996 Sustainable Fisheries Act, an Essential Fish Habitat (EFH) assessment is necessary for this project. An EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." *Waters* include aquatic areas and their associated physical, chemical, and biological properties that are used by fishes and may include areas historically used by fishes. *Substrate* includes sediment, hardbottom, structures underlying the waters, and any associated biological communities. *Necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. *Spawning, breeding, feeding, or growth to maturity* covers all habitat types used by a species throughout its life cycle. Only species managed under a Federal fishery management plan (FMP) are covered (50 C.F.R. 600). The act requires Federal agencies to consult on activities that may adversely influence EFH designated in the FMPs. The activities may have direct (e.g., physical disruption) or indirect (e.g., loss of prey species) effects on EFH and may be site-specific or habitat-wide. The adverse result(s) must be evaluated individually and cumulatively.

3.1 Assessment

The Port lies in the north side of Biscayne Bay, a shallow subtropical lagoon that extends from the City of North Miami (Miami-Dade County, Florida) south to the northern end of Key Largo (at the juncture of Miami-Dade and Monroe Counties). Biscayne Bay is a long, narrow, water body approximately thirty-eight miles long, and three to nine miles wide. Average depth is six to ten feet (USACE 1989). Biscayne Bay is bordered on the west by the mainland of peninsular Florida and on the east by both the Atlantic Ocean and a series of barrier islands consisting of sand and carbonate deposits over limestone bedrock (Hoffmeister 1974).

A thin layer of sediment less than six inches in depth characterizes the bay bottom over most of its area. Sediment thickness is increased up to 40 inches in the northern part of the Biscayne Bay near Miami Beach. Two major natural communities inhabit the bay bottom: seagrass communities and hardbottom communities. In the Atlantic Ocean, waterward of Biscayne Bay and barrier islands, similar communities occur. Nearshore seagrass beds give way to mixed seagrass and hardbottom, deeper channels and, finally, the Florida Reef Tract, which runs from Soldier Key south through the Florida Keys.

The most obvious direct impact of the Recommended Plan on managed species in all habitats would be the potential for mortality and/or injury of individuals through the dredging and/or blasting processes. Species in any and all of the project area’s habitats are susceptible. Fishes and invertebrates are at risk at any life-history stage. Eggs, larvae, juveniles, and even adults may be inadvertently killed, disabled, or undergo physiological stress, which may adversely affect behavior or health. Forms that are less motile, such as juvenile shrimp, are particularly vulnerable.

Blasting would also have a direct impact on managed fish species residing in/migrating through the harbor and associated waterways. Previous studies (USACE 1996; O' Keefe 1984; Keevin and Hempen 1997; Young 1991) have addressed the impacts of blasting on fishes. Fishes with air bladders are particularly more susceptible to the effects of blasting than aquatic taxa without air bladders such as shrimp and crabs (Keevin and Hempen 1997). Small fish are the most likely to be impacted.

Although dredge operations are likely to directly impact individuals of managed species in observable lethal and sublethal ways, dredging and blasting may also have more subtle effects observable only at the population level, rather than at the individual level. For example, dredging/blasting activities, particularly in linear corridors (such as Government Cut and Fisherman's Channel) may temporarily interfere with existing migration patterns of species that require utilization of both inshore and offshore habitats through ontogeny. This is a particular concern for species that travel along shorelines and bulkheads. Therefore the dredging of berths and littoral zone habitats is anticipated to have greater effects. These impacts may result in displacement of individuals or disjuncture in the life cycles of managed species.

Impacts to the water column can have effects on marine and estuarine species. Hence, it is recognized as EFH. The water column is a habitat used for foraging, spawning, and migration by both managed species and organisms consumed by managed species. Water quality concerns are of particular importance in the maintenance of this important habitat. During dredging in substrates comprising coarser materials and rock, water quality impacts are expected to be minimal. However, where silt and/or silty sand are to be dredged, water quality impacts are expected to occur due to temporarily increased levels of turbidity. Re-suspended materials may interfere with the diversity and concentration of phytoplankton and zooplankton, and therefore could affect foraging success and patterns of schooling fishes and other grazers that comprise prey for managed species. Foraging patterns are expected to return to normal soon after cessation of dredging activities.

The temporary or permanent loss of EFH habitats results in the loss of substrates used by managed species for spawning, nursery, foraging, and migratory/temporary habitats. The most critical losses of EFH would be those areas additionally designated as Habitat Areas of Particular Concern (HAPC) such as seagrass beds, , hardbottoms, and reefs. Coastal inlets are HAPC for shrimps, red drum, and grouper. These species prefer estuarine, inshore habitats such as mangroves, seagrass beds, and mudflats for portions of their life histories. Medium and high profile reefs are also considered HAPC for grouper, and the hardbottom existing in 5 to 30 meters of depth off of Miami-Dade County is listed as HAPC for corals and coral reefs (SAFMC 1998a).

Losses to EFH-HAPC within the areas proposed for dredging under Alternative 1 include impacts to seagrass and hardbottom/reef habitats. Seagrass beds are an important part of the Biscayne Bay ecosystem due to their proximity to reef and hardbottom habitats. Their function is closely coupled with reefs to provide life-stage-specific habitat for certain managed species. Seagrass habitat directly adjacent to the existing Port channels are subjected to daily manmade and natural disturbances that make it a less optimal habitat for managed species relative to the surrounding area. Therefore, the selection of Alternative 2 as the Recommended Plan greatly minimizes the significance of seagrass impacts to managed species in terms of both quantity and quality. Nevertheless, loss of these two habitats (hardbottom/reef and seagrasses) would result in a loss of habitat essential in the spawning and early life-stages for species of the Snapper-Grouper Complex, including blue stripe grunts, French grunts, mahogany snapper, yellowtail snapper, and red grouper. Managed crustaceans including pink shrimp and spiny lobster found in nearby mangrove habitats at Virginia Key also likely use grassbeds for foraging during some life stages.

Impacts to populations of managed species would occur due to dredging unvegetated habitats (sand/silt/rubble, sand), including those that lack seagrasses. Dredging would remove benthic organisms used as prey by managed species and as a result may temporarily impact certain species, such as red drum, that forage largely on such taxa. Dredged habitats are anticipated to recover, in terms of benthic biodiversity and population density, within two years (Taylor et. al 1973; Culter and Mahadevan 1982; Saloman et. al 1982).

The aquatic communities associated with these different bottom types and the water column have been identified as EFH in accordance with the amendment to the Fishery Management Plans of the South Atlantic Region (SAFMC 1998). Impacts associated with widening and deepening of the harbor have been minimized with the Recommended Plan and remaining impacts under that alternative are unavoidable. However, the temporary disruption of the water column, seagrass beds, sand bottom, and hardbottom areas that may provide habitat or contribute to aquatic food chains would be minimized by implementing strict management practices to reduce turbidity. These practices along with the construction of new seagrass and hardbottom habitat should mitigate for any direct impacts.

3.2 Managed Species

Thirty-seven fish species are listed under the Affected Fishery Management Plans and Fish Stocks of the Comprehensive EFH Amendment (SAFMC 1998). Consequently, the project area has been designated as EFH for theses fishes, brown shrimp, white shrimp, pink shrimp, and spiny lobster (Table 4). Six coastal migratory pelagic fish species have been included owing to their distribution patterns along the Florida coast. In addition, the nearshore bottom and offshore reef habitats of South Florida have also been designated as EFH-Habitat Areas of Particular Concern (EFH-HAPC) (SAFMC 1998). Over 60 species of coral can occur off the coast of Florida all of which fall under the protection of the management plan (SAFMC 1998). At least 11 genera of mostly gorgonian corals have been observed in the study area.

Table 4 Managed Species Identified by the South Atlantic Fishery Management Council That Are Known to Occur in Miami-Dade County, Florida

Common Name	Taxa
Balistidae	
Gray Triggerfish	*Balistes capriscus*
Queen Triggerfish	*Balistes vetula*
Ocean Triggerfish	*Canthidermis sufflamen*
Carangidae	
Yellow Jack	*Caranx bartholomaei*
Blue Runner	*Caranx crysos*
Crevalle Jack	*Caranx hippos*
Bar Jack	*Caranx rubber*
Greater Amberjack	*Seriola dumerili*
Coryphaenidae	
Dolphin [1]	*Coryphaena hippurus*
Ephippidae	
Spadefish	*Chaetodipterus faber*
Haemulidae	
Black Margate	*Anisotremus surinamensis*
Porkfish	*Anisotremus virginicus*
Margate	*Haemulon album*
Tomtate	*Haemulon aurolineatum*
Smallmouth Grunt	*Haemulon chrysargyreum*
French Grunt	*Haemulon flavolineatum*
Spanish Grunt	*Haemulon macrostomum*
Cottonwick	*Haemulon melanurum*
Sailors Choice	*Haemulon parra*
White Grunt	*Haemulon plumieri*
Blue Stripe Grunt	*Haemulon sciurus*
Labridae	
Puddingwife	*Halichoeres radiatus*
Hogfish	*Lachnolaimus maximus*
Lutjanidae	

Common Name	Taxa
Mutton Snapper	*Lutjanus analis*
Schoolmaster	*Lutjanus apodus*
Gray Snapper	*Lutjanus griseus*
Dog Snapper	*Lutjanus jocu*
Mahogany Snapper	*Lutjanus mahogoni*
Lane Snapper	*Lutjanus synagris*
Yellowtail Snapper	*Ocyurus chrysurus*
Rachycentridae	
Cobia [1]	*Rachycentron canadum*
Scombridae	
Little Tunny [1]	*Euthynnus alletteratus*
King Mackerel [1]	*Scomberomorus cavalla*
Spanish Mackerel [1]	*Scomberomorus maculates*
Cero [1]	*Scomberomorus regalis*
Serranidae	
Black Sea Bass	*Centropristis striata*
Rock Hind	*Epinephelus adscensionis*
Goliath Grouper	*Epinephelus itajara*
Red Grouper	*Epinephelus morio*
Black Grouper	*Mycteroperca bonaci*
Gag	*Mycteroperca microlepis*
Sparidae	
Sheepshead	*Archosargus probatocephalus*
Jolthead Porgy	*Calamus arctifrons*
Invertebrates	
Brown Shrimp	*Farfantepenaeus aztecus*
Pink Shrimp	*Farfantepenaeus duorarum*
White Shrimp	*Litopenaeus setiferus*
Spiny Lobster	*Panulirus argus*

[1] Coastal Migratory Pelagic Fish Species

The species addressed in this section consist of fishes and invertebrates of both recreational and commercial importance that are managed under the Magnuson-Stevens Fishery Conservation and Management Act (PL94-265).

3.2.1 Crustacea

3.2.1.1 Life Histories

3.2.1.1.1 Brown Shrimp

Brown shrimp larvae occur offshore and migrate from offshore as post-larvae from January through November with peak migration from February through April. Post-larvae move into the estuaries primarily at night on incoming tides. Once in the estuaries, post-larvae seek out the soft silty/muddy substrate common to both vegetated and non-vegetated, shallow estuarine environments. This environment yields an abundance of detritus, algae, and microorganisms that comprise their diet at this developmental stage. Post-larvae have been collected in salinities ranging from zero to 69 ppt with maximum growth reported between 18° and 25°C, peaking at 32°C (Lassuy 1983). Maximum growth, survival, and efficiency of food utilization have been reported at 26°C (Lassuy 1983). The density of post-larvae and juveniles is highest among emergent marsh and submerged aquatic vegetation (Howe et al. 1999; Howe and Wallace 2000), followed by tidal creeks, inner marsh, shallow non-vegetated water, and oyster reefs. The diet of juveniles consists primarily of detritus, algae, polychaetes, amphipods, nematodes, ostracods, chironomid larvae, and mysids (Lassuy 1983). Although some of their potential prey would initially be lost during dredging activities, recovery would be rapid (Culter and Mahadevan 1982; Saloman et al. 1982) and they can forage in adjacent areas that have not been impacted as they emigrate offshore. Emigration of sub-adults from the shallow estuarine areas to deeper, open water takes place between May through August, with June and July reported as peak months. The stimulus behind emigration appears to be a combination of increased tidal height and water velocities associated with new and full moons. After exiting the estuaries, adults seek out deeper (18 m), offshore waters in search of silt, muddy sand, and sandy substrates. Adults reach maturity in offshore waters within the first year of life.

3.2.1.1.2 Pink Shrimp

Of the three penaeid shrimp species, pink shrimp is the most prevalent in Florida waters. Consequently, the pink shrimp fishery is the most economically important of all fisheries in Florida.

Spawning of pink shrimp occurs in oceanic waters at depths of 4 to 48 m and possibly deeper (Bielsa et al. 1983) where adult females lay demersal eggs. Spawning takes place year round in some areas (e.g., Tortugas Shelf), but peak spawning activity appears to coincide with maximum bottom water temperatures (Bielsa et al. 1983). Recruitment of planktonic post-larvae into estuarine and coastal bay nurseries occur in the spring and late fall during flood tides. Post-larvae become benthic at approximately 10 mm TL and prefer areas with a soft sand or mud substrate mixture containing sea-grasses and turtle-grass (Bielsa et al. 1983; Howe et al. 1999; Howe and Wallace 2000). Pink shrimp spend from 2 to 6 months in the nursery ground prior to emigration. During this time there is a dietary shift from nauplii and microplankton to polychaetes, ostracods, caridean shrimps, nematodes, algae, diatoms, amphipods, mollusks, and mysids, regarding post-larvae and juveniles, respectively (Bielsa et al. 1983). Although some of their potential prey would initially be lost during dredging activities, recovery would be rapid (Culter and Mahadevan 1982; Saloman et al. 1982) and they can forage in adjacent areas that have not been impacted as they emigrate offshore. Emigration from the nursery grounds to offshore occurs year round with a peak during the fall and a smaller peak during the spring. The greatest concentrations of adults have been reported between 9 and 44 m, although some have been found as deep as 110 m in Florida waters. Although detailed dietary studies concerning adults are non-existent, Williams (1955) reported foraminiferans, gastropod shells, squid, annelids, crustaceans, small fishes, plant material, and debris in the stomachs of adults collected in North Carolina estuaries.

3.2.1.1.3 White Shrimp

White shrimp spawn along the South Atlantic coast from March to November, with May and June reported as peak months along the offshore waters of northeast Florida. Spawning takes place in water ≥ 9 m deep and within 9 km from the shore where they prefer salinities of ≥ 27 ppt (Muncy 1984). The increase in bottom water temperature in the spring is thought to trigger spawning. After the demersal eggs hatch, the planktonic post-larvae live offshore for approximately 15 to 20 days. During the second post-larval stage, they enter Florida estuaries in April through early May by way of tidal currents and flood tides and become benthic. During this larval stage, the diet consists of zooplankton and phytoplankton. It has been documented that juvenile white shrimp tend to migrate further upstream than do juvenile pink or brown shrimp; as far as 210 km in northeast Florida (Pérez-Fartante 1969). Juveniles prefer to inhabit shallow estuarine areas with a muddy substrate with loose peat and sandy mud and moderate salinity. Juvenile white shrimp are benthic omnivores (e.g., fecal pellets, detritus, chitin, bryozoans, sponges, corals, algae, annelids) and feed primarily at night. White shrimp usually become sexually mature during the calendar year after they hatched. The emigration of sexually mature adults to offshore waters is influenced primarily by body size, age, and environmental conditions. Studies have shown that a decrease in water temperature in estuaries triggers emigration in the south Atlantic (Muncy 1984). The life span of white shrimp usually does not extend beyond one year.

3.2.1.1.4 Spiny Lobster

The spiny lobster inhabits the coastal waters from North Carolina to Rio de Janeiro, Brazil, including Bermuda and the Gulf of Mexico. The Florida spiny lobster is a valuable species both commercially and recreationally, and supports Florida's second most valuable shellfishery. During its life cycle, the spiny lobster occupies three different habitats (Marx and Herrnkind 1986). The phyllosoma larvae are planktonic and inhabit the epipelagic zone of the Caribbean, Gulf of Mexico, and the Straits of Florida. The duration of the phyllosome stage is approximately 6 to 12 months. A brief (several weeks) non-feeding, oceanic phase follows, where the larva metamorphoses into a puerulus offshore. The pueruli migrate to shore by night using specialized abdominal pleopods. Large concentrations of pueruli have been recorded along the southeast Florida coast and the southern shores of the Florida Keys year round, with a peak in the spring and a lesser peak in the fall. In addition, these large concentrations are usually associated with the new and first quarter lunar phases. When suitable inshore substrate is encountered by pueruli, they rapidly settle out of the water column and within days molt into the first juvenile stage. The specific factors that stimulate post-larval settlement are not well understood. Known nursery areas of young benthic larvae and juveniles consist of macroalgae beds along rocky shorelines interspersed with seagrasses where they live a solitary existence (Marx and Herrnkind 1986). Juveniles larger than 20 mm CL tend to aggregate in biotic (e.g., sponges, small coral heads, sea urchins) and abiotic (ledges) structures in protected bays, including estuaries with high salinity. As adults, spiny lobsters inhabit coral reef crevices, rocky outcroppings, and ledges. Refuge availability plays an important role regarding population distribution because spiny lobsters do not have the ability to construct dens. However, in a study where additional artificial structures were placed in Biscayne Bay, FL, the population was re-distributed, but the number of spiny lobsters in Biscayne Bay did not increase (Marx and Herrnkind 1986). Consequently, the south Florida population may be limited by recruitment, emigration, food, and other factors.

3.2.1.2 Summary of Impacts to Shrimps and Spiny Lobsters

As outlined by SAFMC (1998), EFH-HAPCs for penaeid shrimps include coastal inlets and both state identified overwintering areas and nursery habitats. Seagrass beds common to the bays of Florida are particularly important areas. EFHs for spiny lobster are varied including nearshore shelf/oceanic waters, shallow, benthic subtidal areas, seagrass beds, soft sediment, coral and both live and hardbottom, sponges, algal communities, mangroves, and the Gulf Stream which it uses for dispersion (SAFMC 1998).

The project area includes sand bottom, sand-veneered hardbottom, hardbottom, and water column that may be used by all three penaeid species and spiny lobster as post-larvae, juvenile, and adults. The project would impact a relatively small area of the sand and hardbottoms, and the impacts would be minor. Some possible refuge may be lost in regards to the impact to the hardbottom areas; however, additional refuge would be created by the construction of artificial reefs to serve as replacement habitat. The project would cause localized turbidity during construction; however, turbidity would be minimized using the best management practices so that any impacts would be minor and temporary. Penaeid shrimp and spiny lobster would be temporarily displaced, but would quickly return to the project area.

3.2.2 Habitat Areas of Particular Concern

3.2.2.1 Hardbottom and Reef Habitat

The South Atlantic Fisheries Management Council has designated nearshore hardbottom and offshore reef areas within the study site as EFH. The nearshore bottom and offshore reef habitats of South Florida have also been designated as EFH-HAPC (SAFMC 1998). Over 60 species of coral can occur off the coast of Florida all of which fall under the protection of the management plan (SAFMC 1998).

The warm waters of the Florida current are the most dominant hydrographic feature beginning at Palm Beach, Florida, and continuing south. As a result, the Carolinian corals in the Palm Beach area (> 4 km offshore) are replaced by a highly diverse hardbottom community that is dominated by gorgonian corals off Miami-Dade County (USACE 1989 and 1996a, SAFMC 1998). Observed gorgonians during a recent video survey of the project area were primarily of the genera *Eunicea* (e.g., *E. palmeri)*, *Plexaura* (e.g., *P. homomalla)*, and *Pseudopterogorgia* spp. (DC&A 2001). Other observed genera included *Gorgonia*, *Plexaurella* (*P. dichotoma)*, and *Pterogorgia* (*P. citrina* and *P. anceps),* and *Pseudoplexaura* spp. Hard coral species also make up a significant part of the reef assemblages in this area. The dominant species of hermatypic corals in this area include the large star coral, *Montastraea cavernosa*, the small star coral, *M. annularis*, *Diploria clivosa, Siderastrea siderea,* and *Porites asteroides,* (Blair and Flynn 1989; SAFMC 1998). All five of these dominant species were observed during the 2000 survey (DC&A 2001). Sponges observed within the project area's hardbottoms and reefs during the survey included *Ircinia campana*, *Callyspongia vaginalis*, *Cliona* sp., *Iotrochota* sp. (*I. birotulata*), *Geodia* spp. (*G. gibberosa* and *G. neptuni*) and *Amphimedon compresa*. The biota of the three outer reef tracts are consistent with the overall assemblage of stony corals, sponges, and gorgonians found offshore of Miami-Dade, Broward, and Palm Beach Counties (USACE 2000). Colonizing taxa such as sponges and certain gorgonians were more prevalent in the channel's hardbottom areas then were hard corals. Observed algal species in both channel and offshore areas included *Caulerpa* spp., *Laurencia* spp., *Cladophora* spp., and *Halimeda* spp. Flynn et al. (1991) noted the additional presence of *Dictyota* spp. and *Jania* spp. in the area.

3.2.2.2 Summary of Impacts to Hardbottom and Reef Habitat

Direct impacts to hardbottom and reef communities would occur as a result of the dredging process to deepen and widen channels within the Port. Areas that have been dredged previously would be affected. In total there would be 49.4 acres of impact to hardbottom/reef habitat within the existing channel including 28.7 acres of low relief hardbottom/reef and 20.7 acres of high relief hardbottom/reef. Of this total 49.4 acres of combined hardbottom/reef impacts, 46.1 acres are areas that have been previously dredged and recolonized. In addition, the proposed project would temporarily impact established hardbottom habitat on the limestone walls of the existing channel. Inshore channel walls may also function as hardbottom, in particular the inshore wall habitat of Fisherman's Channel would be impacted with the proposed widening

Due to the lack of research and long-term monitoring on nearshore hardbottom/reef communities, determining what amount of cumulative impact is significant is difficult. Past impacts within the region do not appear to have had any adverse or significant cumulative impact on the resource. Proposed future actions would add cumulatively to the impact and are adverse. Due to the significant amount of adjacent habitat remaining, it is unlikely that the amount of hardbottom habitat would become a limiting resource. Consequently, the impacts are most likely adverse, but not significant, since the adjacent habitat is clearly not limited. Also, addition of new artificial reef proposed as mitigation would replace the proposed losses of high and low relief hardbottom/reef.

3.2.2.3 Seagrass Habitat

Seagrass habitat cover type and characteristics for the study area are described below. Distribution and occurrence observations were surveyed `from approximately 400 feet south of Fisherman's Channel, including the area of the CWA, and the area adjacent to the Coast Guard Station north of the entrance channel at the southern tip of Miami Beach.

Marine seagrass species observed within the study area included *Halodule wrightii, Halophila decipiens, Syringodium filiforme* and *Thalassia testudinum.* Seagrass occurrence in these areas consisted of mixed beds of *H. decipiens* and *H. wrightii,* mixed beds of *H. wrightii, and T. testudinum,* mixed beds of *T. testudinum and S. filiforme,* mixed beds of all species and, monospecific beds of *T. testudinum*, and *H. decipiens*. No *H. johnsonii* was observed while surveying (DCA 2001, nor has any been reported from the study area by resource agencies or other sources.

Review of historic aerial photography over an approximate ten-year period (1989 to 1998) shows that major seagrass coverage patterns have essentially remained the same in the harbor and BSCWA. Site-specific coverage patterns along Fisherman's Channel revealed that the "colonizing" species, especially *H. wrightii* and *H. decipiens* tended to occur along the turning basins and nearshore areas in softer sediments with higher chronic turbidity. In fact some *H. decipiens* beds near the turning basins were covered with heavy silt loads. These colonizing species may predominate closer to shore because they can better withstand daily fluctuations in water quality. Mixed beds of the more climactic species, *T. testudinum* and *S. filiforme*, were predominant in silty sand substrate along Fisherman's Channel. This area may experience more flushing by high tides and a more stable substrate with less chronic resuspension. All seagrass beds were patchy and interspersed with bare substrate and density of individual beds decreased from east to west. The seagrass communities located directly along the channel edge are of moderate quality when compared to the seagrasses in the surrounding area, especially to the south. Daily water quality perturbations from runoff, river flushing, shipping activities and propeller dredging by recreational boaters create a less stable, less diverse habitat although nutrient loads are probably exploited by some marine species at times.

Seagrass communities provide important habitat for many different species of flora and fauna. *Caulerpa prolifera* was observed in video transects associated with *H. wrightii*, and algae of the genera *Udotea* and *Penicillus* were also observed in the field along the channel edge. Many invertebrate species also utilize seagrass communities. There is a prevalence of bottom feeders in the beds directly along the channel edge including queen conch (*Strombus gigas*), urchins such as the sea biscuit (*Clypeaster* spp.), nudibranchs, bivalve mollusks, and crustaceans including the spiny lobster (*Panulirus argus*), and the blue crab (*Callinectes sapidus*). Filter feeders such as soft corals and sponges were observed scattered within adjacent seagrass beds, especially in the BSCWA where increased water clarity appeared to allow a more diverse and higher quality habitat (see species listed in Section 3.2). Many fish species have also been shown to have life cycles dependent on seagrass beds. Of particular importance are the mullet (*Mugil cephalus*), snook (*Centropomis undecimalis*), and many prey species including mojarras and pinfish. Seagrass beds are also important nurseries for many of the fish associated with SAFMS Snapper-Grouper Complex (SAFMC 1998b).

3.2.2.4 Summary of Impacts to Seagrass Habitat

Direct impacts as a result of Components 3B and 5A include the removal and sloughing of seagrass habitat along Fisherman's Channel and Fisher Island Turning Basin during dredging activities. Dredging associated with deepening and widening would impact a total of 0.2 acre of seagrass habitat by removal of substrate, and an estimated additional loss of 6.1 acres due to side slope equilibration of adjacent substrate.

Direct impacts associated with the removal of these seagrass beds include the loss of habitat and functional values attributable to submerged aquatic vegetation. The reduction of seagrass beds in the areas inside the proposed new channel and in areas immediately adjacent to dredging activities may result in the direct loss of forage for manatees. This impact would be significant for Component 6, which includes several acres of seagrass removal from an area of frequent manatee occurrence. Component 6 (see Alternative 1) was therefore rejected. Component 5A has a greatly reduced impact because of the much lower quantity and lower relative quality of the habitat and because of its location directly along the channel. Loss of habitat for seagrass bed resident and transient fish and invertebrates may also result. Mitigation offered for seagrass impacts would result in replacement of lost habitat values.

Deepening/widening of the Fisher Island Turning Basin (Component 3B) would not directly impact seagrass communities but may include some indirect effects on seagrass habitats, particularly those immediately to the northeast (a large mixed-species bed of *H. decipiens* and *H. wrightii*) and southeast (an isolated *H. decipiens* bed associated with the littoral zone of Fisher Island) of the proposed dredging activity. Assuming a three to one cut for the basin widening and deepening and a 1:7 slope equilibrium profile from subsidence of the adjacent sand shelf, the seagrass beds to the northeast would not be directly impacted. For the remaining three project components (1C, 2A, and 4), direct and/or indirect impacts to seagrass beds are not anticipated. No impacts would occur due to Component 2A (widening the channel at the intersection of Government Cut and Fisherman's Channel). Resources within 2,000 feet of the proposed dredge site for that component includes an isolated *H. decipiens* bed (over 500 feet away), and a large mixed-species (*H. decipiens* and *H. wrightii*) bed (over 750 feet away). Since material to be dredged as a part of Component 2A principally comprises limestone, sandstone, and clean quartz sand (USACE 2001) transport and deposition of fine sand/ silt onto the nearby seagrass beds is not expected. Component 1C falls outside Biscayne Bay and inner channels and is not likely to result in any adverse direct or indirect impacts to seagrass. Component 4 does not involve any dredging activity, and would therefore not affect seagrass beds mapped during the 2000 survey (DC&A 2001).

3.2.2.5 Rock/Rubble Habitat

Within the project area there are both naturally occurring rock outcrops and rubble material that has been left from prior dredging events. The most obvious biological features of most of the rock/rubble-based habitats are resident sponges and macroalgae, whereas the remainder of the rock/rubble habitats serves as raw material for reef-building species. The latter case was apparent in the channel zone adjacent to the existing reef tracts. Observed sponge species included *Ircinia campana*, *Callyspongia vaginalis*, and *Iotrochota* sp. (*I. birotulata*). Observed soft corals were similar to those of adjacent reefs, and included the genera *Eunicea*, *Plexaura*, and *Pseudopterogorgia*. Habitats provided by rock and rubble and associated sponges, algae, and soft corals provide significant refugia for many species of juvenile fish.

3.2.2.6 Summary of Impacts to Rock/Rubble Habitat

To implement the Recommended Plan approximately 123.5 acres of combined rock/rubble habitat would be impacted. Of those habitats, 120.5 acres lie within previously dredged areas, and only 3 acres lie outside previously dredged areas. Rock/rubble live bottom habitats composed 51.7 acres of the area to be impacted. All of the rock/rubble live bottom acreage impacted by Alternative 1 has been impacted previously by earlier dredging activity within the Port (Table 12). An additional 68.8 acres of rock/rubble with algae/sponge habitat has been previously dredged and would again be impacted by the Recommended Plan. Three acres of new rock/rubble with sponge/algae habitat impacts would occur with the implementation of Alternative 2.

3.2.2.7 Unvegetated Bottom Habitat

Unvegetated bottom habitat within the study area has been classified as either sand bottom habitat or sand/silt/rubble habitat. Off of Miami-Dade County, unvegetated sand bottom habitats fall between the first and second, and the second and third reef lines within the study area and hence may provide a corridor for reef species to travel between reef lines. They may also be an important foraging area for some fish species (Jones et al. 1991). Other unvegetated sand bottom habitats are located between scattered reef patches and rock/rubble habitats both within and adjacent to the channel and between seagrass beds that occur outside the channel. Areas surveyed along the channel edge in the Port (within 400 feet perpendicular) were classified as unvegetated bottom if no seagrass/algae beds were recorded and mapped. The unvegetated sand bottom just west of the Lummus Island Turning Basin is an example (DC&A 2001. The unvegetated-sand/silt/rubble habitat is found within Fisherman's Channel, and occurs as a patchy mosaic of each of these components.

Softer silty-sand substrates occurred mainly inshore, while unvegetated habitats offshore included some bare sand substrate over rock with sparse algae. During the summer months, the most abundant of these algal species found in the study area belong to the green algae genera *Caulerpa*, *Halimeda*, and *Codium* (USACE 1989 and 1996). The former two taxa were observed during summer 2000 surveys (DC&A 2001. In winter months, brown algae (*Dictyota* spp. and *Sargassum* spp.) dominate (USACE 1989 and 1996). In addition, several species of sponges (e.g., *I. campana*, *C. vaginalis*, and *Iotrochota* sp.) and gorgonians (e.g., *Eunicia* spp. and *Gorgonia* sp.) were observed along transects through unvegetated habitats. Individual colonies of algae, soft corals, and sponges that occasionally occur in these areas where little structure is available may serve to provide temporary refugia for small, motile species. Invertebrate fauna utilizing sand bottom areas include the Florida fighting conch (*Strombus alatus*), milk conch (*Strombus costatus*), king helmet (*Cassia tuberosa*), and the queen helmet (*Cassia madagascariensis*) (USACE 1996).

The most ubiquitous infauna of inshore softer sand/silt/rubble communities include polychaete and sipunculan worms, oligochaetes, platyhelminthes, nemerteans, mollusks, and peracarid crustaceans. Compared to shallow sand flats, seagrass communities, and areas adjacent to reef tracts, the deeper, dredged areas of the channel and Port likely support a less diverse infaunal species assemblage and are a lower quality habitat.

3.2.2.8 Summary of Impacts to Unvegetated Bottom Habitat

Unvegetated sand/silt/rubble and sandy bottom habitats comprise a significant proportion or the total area proposed for dredging. In areas where these habitats may comprise minor associates of other major habitat categories (such as seagrass beds, rock/rubble, or reef), substrata were not categorized as “unvegetated softbottom” during recent surveys (see DC&A 2001) unless the condition was clearly dominant. Wide expanses of this type of community in its natural state are found only in the area comprising Component 1C, but smaller tracts are also presented adjacent to seagrass habitats along the south side of Fisherman's Channel and between the Lummus and Dodge Island Turning Basins. Direct impacts to unvegetated communities (due to dredging operations) in all three of these areas would mainly include impacts to benthic epifauna and infauna with the magnitude of impacts differing according to location. In total there would be 68.2 acres of unvegetated habitat impacted during dredging under Component 1C and the vast majority of this acreage, comprises previously dredged substrate (66.9 ac). The USACE believes that benthic infaunal populations in these areas would recolonize after dredging operations are complete. The degree to which the substrate remains viable for benthos may depend on light attenuation relative to additional eight feet of depth. Increased depth may not promote the growth of macroalgae and epipsammic algae.

In comparison, impacts to unvegetated habitats within Component 3B would entail direct removal of 24.4 acres of unvegetated habitat, 19.1 acres of which has been dredged previously.

The largest impact acreages in the Recommended Plan to unvegetated communities occur with Component 5A mainly within the previously dredged channel. Approximately 143.8 acres of the area proposed for dredging under Component 5A includes unvegetated bottom. Of this, 127.1 acres is from previous dredging activities, while an additional impact of 16.73 acres of habitat that has not been dredged previously is also required to complete this part of the project of which 39.3 is from previous dredging activities.

Impacts to benthic infaunal and epifaunal communities would be considered as relatively minimal when examined on a spatial scale. Infaunal communities in particular have very high reproductive potential and recruitment. Adjacent areas that have not been impacted would most likely be the primary source of recruitment to the impacted areas. Previous studies have shown a relatively short recovery time for infaunal communities following dredging (Taylor et. al 1973, Culter and Mahadevan 1982; Saloman et. al 1982). Succession of infaunal communities post dredging should begin within days following construction. This initial settlement usually consists of pelagic larval recruits settling within the impact area. Later recruitment from adjacent non-impacted areas would be more gradual, and involve less opportunistic species. Saloman et al. (1982) stated that communities would be close to pre-dredge conditions within one year and potentially as quickly as 8 to 9 months. Culter and Mahadevan (1982) found similar results and no long-term effects to benthic communities resulting from dredging activities. Based on these previous studies infaunal communities would most likely be re-established within 1 to 2 years post dredging.

3.2.3 South Atlantic Snapper-Grouper Complex

Miami-Dade County, Florida is designated as EFH for 37 species of reef fishes (Table 1) that are listed under the Affected Fishery Management Plans and Fish Stocks of the Comprehensive EFH Amendment (SAFMC 1998). Collectively, these 37 species, representing eight different families, are all members of the 73 species Snapper-Grouper Complex as outlined by SAFMC (1998). The association of these fishes with coral or hardbottom structure, vegetated and unvegetated inshore areas during some period of their life cycle, and their contribution to a reef fishery ecosystem is why they are included in the snapper-grouper plan. A discussion of how these fishes utilize the different inshore habitats and the hardbottom and reef communities follows.

3.2.3.1 Life History

<u>3.2.3.1.1</u> <u>Balistidae</u>

Miami-Dade County is designated as EFH for three species of triggerfishes (Table 1). Collectively, these triggerfishes inhabit shallow inshore areas (e.g., bays, harbors, lagoons, sandy areas, grassy areas, rubble rock, coral reefs, artificial reefs, or dropoffs adjacent to offshore reefs) to offshore waters as deep as 275 m. These triggerfishes, especially the gray and queen triggerfish are an important component of the reef assemblage of both natural and artificial reefs (Vose and Nelson 1994). Information regarding balistid reproduction is limited and varied (Thresher 1984). The basic balistid (e.g., gray triggerfish) spawning behavior involves the production of dermersal, adhesive eggs that are thought to stick to corals and algae near or on the bottom. On the other hand, spawning of both the ocean and queen triggerfish takes place well off the bottom over relatively deep water where pelagic eggs are released. Unfortunately, egg and larval development is poorly understood regarding most species; however, a long ($\geq$ 1 yr) planktonic stage appears common for many species. As juveniles, it has been suggested that they are planktonic, taking refuge among floating masses of *Sargassum* (Johnson and Saloman 1984). During this stage of development, the diet consists of primarily zooplankton associated with the *Sargassum* or drifting in the water column. The exact timing or the environmental cues that trigger settlement is not well understood. However, juvenile gray triggerfish as small as 16 - 17 cm SL have been reported to colonize hardbottom habitats (Thresher 1984). After juveniles take on a benthic existence, their diet shifts to benthic fauna including algae, hydroids, barnacles, and polychaetes. All triggerfish feed diurnally and are well adapted to prey upon hard-shell invertebrates, especially adults. The diet of adult ocean triggerfish includes large zooplankton and possibly drifting seagrasses, algae, mollusks, and echinoderms. Adult gray and queen triggerfish feed primarily on sea urchins, but in their absence, would shift to other benthic invertebrates such as crabs, chiton, and sand dollars (Frazer et al. 1991; Vose and Nelson 1994). All three triggerfishes are commercially important (especially the queen triggerfish) in the aquarium trade and to some extent as a gamefish.

<u>3.2.3.1.2</u> <u>Carangidae</u>

Miami-Dade County is designated as EFH for five carangids (Table 1) because they utilize the offshore and possibly inshore areas adjacent to the study area. Spawning of the bar jack, yellow jack, blue runner, and the crevalle jack takes place in offshore waters associated with a major current system such as the Gulf Stream from February through September (Berry 1959). Consequently, these four species have an offshore larval existence. Data indicates that peak spawning months for blue runners is May through July (Shaw and Drullinger 1990). Although spawning data regarding the greater amberjack doesn't exist, it is assumed that it is similar to the other four species. As young juveniles, crevalle jack migrate into inshore waters at about 20 mm SL whereas blue runners don't migrate into inshore areas until their late juvenile stage (Berry 1959). Young bar jacks have a tendency to remain offshore and yellow jacks occur inshore only occasionally as juveniles (Berry 1959). Based on collections of juveniles regarding these four species, there is some indication that there is a mobile, northward population of developing young in the Gulf Stream that developed from spawning that occurred in more southern waters (Berry 1959).

As juveniles and sub-adults, blue runners occur singly or in schools while juveniles have a high affinity for *Sargassum* and other floating objects in the Gulf Stream off southeast Florida (Goodwin and Finucane 1985). Blue runners are a fast growing, long-lived specie which attains 75 percent of its maximum size in its first 3 to 4 years of life (Goodwin and Johnson 1986). The greater amberjack is a far ranging species that inhabits inlets, shallow reefs, rock outcrops, and wrecks with reef fishes such as snappers, sea bass, grunts, and porgies (Manooch and Potts 1997a). They are generally restricted to the continental shelf to depths as great as 350 m (Manooch and Haimovici 1983). Small individuals (< 1 m SL) are usually found in water < 10 m deep while larger individuals frequent waters 18 - 72 m deep (Manooch and Potts 1997b). Greater amberjack are a fast growing species and are recruited to the headboat fishery in the Gulf by age 4 and fully recruited to the fishery by age 8 (Manooch and Potts 1997a; Manooch and Potts 1997b).

All five carangids are popular sport fishes among recreational fishers, but not as popular commercially where they are harvested using handlines, bottom longlines, and in some cases traps and trawls. Some Florida fishers feel that amberjack are being exposed to too much fishing pressure, especially owing to their attraction to reefs which make them an easy target for overfishing (Manooch and Potts 1997a). However, as of 1997 there is no evidence of overfishing in both the Gulf of Mexico and southeast Florida (Manooch and Potts 1997b).

3.2.3.1.3 Ephippidae

Miami-Dade County is designated as EFH for the spadefish because as juveniles it inhabits shallow sandy beaches, estuaries, jetties, wharves, and other inshore areas, as well as deeper offshore habitats as adults. Spawning which takes place from May to September involves an offshore migration as far as 64.4 km (Chapman 1978; Thresher 1984). Although no data exists regarding egg and larvae development in nature, small individuals (~ 1-2 cm TL) appear inshore in early summer (Walker 1991). These small juveniles are commonly observed drifting motionless along side vegetation (e.g., *Sargassum*). It has been suggested that they mimic floating debris and vegetation to escape predation. As spadefish mature they move further offshore where large schools would take residence around wrecks, oil and gas platforms, reefs, and occasionally open water. Spadefish are opportunistic feeders, preying upon a variety of items including small crustaceans, worms, hydroids, sponges, sea cucumbers, salps, anemones, and jellyfish. In certain areas, the spadefish is an important game fish.

3.2.3.1.4 Haemulidae

Miami-Dade County is designated as EFH for eleven species of grunts (Table 1). Collectively, these grunts inhabit shallow inshore areas (e.g., estuaries, mangroves, jetties, piers, seagrass beds), coral reefs, rock outcrops, and offshore waters as deep as 110 m. Although most of the life history data concerning grunts (Cummings et al. 1966; Manooch and Barans 1982; Darcy 1983; McFarland et al. 1985; Sedberry 1985) are from studies of tomtate, white grunt, French grunt, blue stripe grunt, and the margate, the general information can probably be applied to the other species as well. As a reef-dwelling species, grunts are probably similar to other roving benthic predators such as snappers and groupers that migrate to select spawning sites along the outer reef and participate in group spawning at dusk. Some data suggests that spawning takes place over much of the year, while other suggests spawning peaks in later winter and spring (Manooch and Barans 1982; Darcy 1983). The eggs are pelagic as well as the planktonic larvae. After this pelagic larval stage that may last several weeks, they settle to the bottom as benthic predators (Darcy 1983). The juveniles are commonly found in seagrass beds, near mangroves, and other inshore, shallow areas. Studies in the Caribbean regarding French grunt, suggested that fertilization and settlement was associated with the lunar cycle (quarter moon, rather than the full or new moon) and daily tidal cycles (rising and falling tides), respectively (McFarland et al. 1985). Juveniles are diurnal planktivores that tend to feed higher in the water column than adults on amphipods, copepods, decapods, and small fishes (Darcy 1983; Sedberry 1985). The transformation to adult involves a change in feeding strategy from diurnal planktivore to nocturnal benthic foraging. Most grunts take refuge near the reef in schools, but at dusk they disperse and forage over the reef, along sandy flats, and grass beds for crustaceans, fishes, mollusks, polychaetes, and ophiuroids. Because of these nocturnal foraging migrations, grunts are a major source of food for higher tropic level, piscivorous fishes. In addition, they are very important to hardbottom reef-related fisheries regarding the energy transfer from sandy expanses to these reefs (Darcy 1983). Several species of grunt such as the tomtate and white grunt have some commercial and recreational importance. Tomtate are commonly caught by sport fishermen from shore, bridges, jetties, and inshore waters by boat. In the southeastern United States, the hook and line fishery is the most important method of commercial harvest regarding tomtate (Darcy 1983). In addition, tomtate are collected using traps, trawls, and seines off southeast Florida. Commercially, tomtate are usually discarded or cut up and used as bait for the grouper or snapper fishery. Similarly, white grunt are commercially harvested by hook and line along the southeast United States and is also a common sport species.

3.2.3.1.5 Labridae

Miami-Dade County is designated as EFH for two species of wrasse (Table 1). The EFH for both species ranges from shallow reef and patch reefs, areas of hard sand and rock, and/or along areas inshore or offshore of the main reef. The puddingwife appears to be depth restricted as it is rare to find this species in waters deeper than 13.3 m, while the hogfish inhabits areas as shallow as 3.3 m deep (Thresher 1980). Reproduction in wrasses involves a complex reproductive system based on protogynous hermaphroditism which features a complex socio-sexual system involving sex reversal, alternate spawning systems and variable color patterns (Thresher 1980). Both species participate in group (the dominant or terminal male with a harem of females) broadcast spawning that occurs along the outer edge of a patch reef or on an extensive reef complex along the outer shelf during the summer months (Thresher 1984). Hogfish spawn during the late afternoon or early evening hours, while puddingwife spawning is synchronized with strong tidal or shoreline currents. Although the exact duration of both the planktonic egg and larval stage is unknown, some records suggest that the latter may be as short as one month before the larvae settle out. Newly settled hogfish and puddingwifes use common areas around grass flats and the shallow reef, respectively. The smallest juvenile on record collected on reefs is approximately 10 mm SL. Other data suggests that puddingwife as small as 30 mm SL may be sexually active. As a benthic predator, the diet of adult hogfish consists of mollusks, echinoderms, and small crustaceans (primarily crabs). Owing to their large size, hogfish are popular with sport fishers.

3.2.3.1.6 Lutjanidae

Miami-Dade County is designated as EFH for seven species of snapper (Table 1). Collectively, the EFH of these snappers ranges from shallow estuarine areas (e.g., vegetated sand bottom, mangroves, jetties, pilings, bays, channels, mud bottom) to offshore areas (e.g., hard and live bottom, coral reefs, rocky bottom) as deep as 400 m (Allen 1985; Bortone and Williams 1986). Like most snappers, these seven species participate in group spawning, which indicates either an offshore migration or a tendency for larger, mature individuals to take residency in deeper, offshore waters. Data suggests that adults tend to remain in one area. Both the eggs and larvae of these snappers are pelagic (Richards et al. 1994). After an unspecified period of time in the water column, the planktivorous larvae move inshore and become demersal juveniles. The diet of these newly settled juveniles consists of benthic crustaceans and fishes. Juveniles inhabit a variety of shallow, estuarine areas including vegetated sand bottom, bays, mangroves, finger coral, and seagrass beds. As adults, most are common to deeper offshore areas such as live and hardbottoms, coral reefs, and rock rubble. However, adult mutton, gray, and lane snapper also inhabit vegetated sand bottoms with gray snapper less frequently occurring in estuaries and mangroves (Bortone and Williams 1986). The diet of adult snappers includes a variety fishes, shrimps, crabs, gastropods, cephalopods, worms, and plankton. All seven species are of commercial and/or recreational importance In particular, the mutton, gray, lane, and yellowtail snapper comprise the major portion of Florida's snapper fishery (Bortone and Williams 1986).

3.2.3.1.7 Serranidae

Miami-Dade County is designated as EFH for six species of sea bass (Table 1). Collectively, the EFH of these sea bass ranges from shallow estuarine areas (e.g., seagrass beds, jetties, mangrove swamps) to offshore waters as deep as 300 m (Heemstra and Randall 1993; Jory and Iverson 1989; Mercer 1989). Like all other serranids, these six species are protogynous hermaphrodites; functioning initially as females only to undergo a sexual transformation at a later time to become functional males. In addition, like all other serrranids, these six species produce offshore planktonic eggs, moving into shallow, inshore water during their post-larval benthic stage. Juveniles inhabit estuarine, shallow areas such as seagrass beds, bays, harbors, jetties, piers, shell bottom, mangrove swamps, and inshore reefs. Juveniles feed on estuarine dependent prey such as invertebrates, primarily crustaceans, that comprise the majority of their diet at this developmental stage. As sub-adults and adults, they migrate further offshore taking refuge along rocky, hard, or live bottom, on artificial or coral reefs, in crevices, ledges, or caverns associated with rocky reefs. During this stage in their lives, the bulk of their diet consists of fishes, supplemented with crustaceans, crabs, shrimps, and cephalopods. Except for the Goliath grouper, the other species discussed in this section have some importance to commercial and/or recreational fisheries.

3.2.3.1.8 Sparidae

Miami-Dade County is designated as EFH for two species of porgy (Table 1). The EFH regarding both species ranges from shallow inshore waters (e.g., vegetated areas, jetties, piers, hard and rock bottoms), to deeper offshore waters with natural or artificial reefs, offshore gas and oil platforms, or live bottom habitat (Darcy 1986). Although nothing is known regarding the sexuality of the jolthead porgy, it is most likely a hermaphroditic species which is widely documented in sparids (Thresher 1984). On the other hand, the sheepshead has been determined to be a protogynous hermaphrodite through histological investigations (Render and Wilson 1992). Information regarding tropical sparids is limited, but in general, it suggests long spawning seasons. Little is known about spawning behavior, but it is presumed that both the sheepshead and the jolthead porgy produce pelagic eggs some distance off the bottom. Whether or not spawning takes place in pairs or in spawning aggregations has not been documented. Settlement of sheepshead larvae to the bottom occurs at about 25 mm TL (Thresher 1984). Based on their dentition, both species are well suited for benthic feeding of sessile and motile invertebrates (e.g., copepods, amphipods, mysids, shrimp, bivalves, gastropods) which are bitten off from hard substrates and vegetation. Neither sparid is considered a schooling species, although they will form small groups composed of several individuals occasionally. There is no direct commercial or sport fishery associated with either sparid; however, both are fished in coastal waters. Both species are an important constituent of grassbed communities in shallow water and live bottom communities in deeper water (Darcy 1986).

3.2.3.2 Summary of the Impacts to the Snapper-Grouper Complex Fishes

The project area includes sand bottom, sand-veneered hardbottom, hardbottom, and water column that may be used by these managed fishes and their prey. The project would impact a relatively small area of the sand and hardbottoms, and the impacts would be minor and short-term. Some possible refuge and related prey may be lost in regards to the impact to the hardbottom, seagrass and sand areas; however, additional refuge would be created by the construction of the artificial reef and seagrass mitigation areas to serve as replacement habitat. The project would cause localized turbidity during construction; however, turbidity would be minimized using the best management practices so that any impacts would be minor and temporary. These fishes and possible prey would be temporarily displaced, but should quickly return to the project area.

3.2.4 Coastal Migratory Pelagics Complex

Miami-Dade County, Florida is designated as EFH for six species of coastal migratory pelagic fishes that are listed under the Affected Fishery Management Plans and Fish Stocks of the Comprehensive EFH Amendment (SAFMC 1998). Collectively, these six species, representing three different families, are all members of the Coastal Migratory Pelagics Fish Species as outlined by SAFMC (1998). The association of these fishes or their prey with coral or hardbottom structure, or inshore waters during some period of their life cycle and their contribution to a reef fishery ecosystem is why they are included in this complex. A discussion of how these fishes utilize the different inshore habitats and the hardbottom and reef communities follows.

3.2.4.1 Life History

<u>3.2.4.1.1</u> <u>Coryphaenidae</u>

The dolphin is oceanic and distributed worldwide in both tropical and subtropical waters. Data suggest that this species may be involved in northward migrations during the spring and summer with some occasional movements and migrations being controlled by drifting objects in open waters. Spawning which is poorly documented, it thought to take place in oceanic waters where pairing of the sexes occurs (Ditty et al. 1994). Based on the occurrence of young dolphin in the Florida Current, spawning may be almost year round (November - July) with peak activity in January through March (Palko et al. 1982). Owing to the oceanic distribution of this species, its not surprising that both the egg and larval stages are pelagic. Upon hatching, this species experiences rapid growth throughout its life with both sexes reaching sexually maturity within the first year (Palko et al. 1982). In the Straits of Florida, female dolphin begin to mature at 350 mm FL and become fully mature at 550 mm FL. On the other hand, the smallest, mature male on record is 427 mm FL. The maximum life span of dolphin is estimated at 4 years. The diet of dolphin alters throughout its life cycle (Palko et al. 1982). As larvae, they feed primarily on crustaceans, with copepods as the primary prey item. Adult dolphin are opportunistic, top-level predators. They feed upon a variety of fishes (e.g., flyingfish) and crustaceans, especially those species commonly associated with drifting flotsam and *Sargassum* in the Florida Current. As a prized food, dolphin are sought by both commercial and sport fishers. They are most commonly taken using hook and line around the edges of the continental shelf. In southern Florida, based on recreational catches, they appear most frequently March through August and then again September through February (Palko et al. 1982).

3.2.4.1.2 Rachycentridae

Cobia are distributed worldwide in tropical, subtropical, and warm temperate waters where they inhabit estuarine and shelf waters depending of their life stage. They appear to associate with structures such as pilings, wrecks and other forms of vertical relief (e.g. oil and gas platforms) and favor the shade from these structures (Mills 2000). Cobia spawn offshore where external fertilization takes place in large spawning aggregations; however, the pelagic eggs have been collected at both inshore and offshore stations. Based on past collections of gravid females, spawning takes place from mid May, extending through the end of August off South Carolina (Shaffer and Nakamura 1989). Consequently, spawning may start slightly early off the southeast coast of Florida. Eggs have been collected in the lower Chesapeake Bay inlets, North Carolina estuaries, in coastal waters 20 - 49 m deep, and near the edge of the Florida Current and the Gulf Stream (Ditty and Shaw 1992). Ditty and Shaw (1992) suggested that cobia spawn during the day since all the embryos they examined were at similar stages of development. Cobia exhibit rapid growth and may attain a length of 2 m FL and are known to live 10 years (Shaffer and Nakamura 1989). Although females grow faster than males, they attain sexual maturity later in life. Sexual maturity is attained by males at approximately 52 cm FL during the second year and at approximately 70 cm FL for females during their third year (Shaffer and Nakamura 1989). They are adaptable to their environment and can utilize a variety of habitats and prey. Cobia are voracious predators that forage primarily near the bottom, but on occasion do take some prey near the surface. Their favorite benthic prey are crabs, and to a much less extent other benthic invertebrates and fishes. No predator studies have been conducted, but dolphin fish have been known to feed on small cobia. Adults may be found solitary or in small groups and are known to associate with rays, sharks, and other larger fishes. Cobia is fished both commercially and recreationally; however, the commercial harvest is mostly incidental in both the hook and line and net fisheries. The recreational harvest is primarily through charter boats, party boats and fishers fishing from piers and jetties. Tagging studies have documented a north-south, spring-fall migration along the southeast United States and an inshore-offshore, spring-fall migration off South Carolina (Ditty and Shaw 1992).

3.2.4.1.3 Scombridae

Miami-Dade County is designated as EFH for six scombrid species (Table 1). Collectively, the EFH of these epipelagic scombrids ranges from clear waters around coral reefs, and inshore and continental shelf waters (Collette and Nauen 1983). Spawning of king and Spanish mackerel takes place May through September with peaks in July and August. The cero is thought to spawn year round with peaks in April through October, whereas little tunny spawn from April to November. Batch spawning takes place in tropical and subtropical waters, frequently inshore. The eggs are pelagic and hatch into planktonic larvae. Both king and Spanish mackerel are involved in migrations along the western Atlantic coast. With increasing water temperatures, Spanish mackerel move northward from Florida to Rhode Island between late February and July, and back in the fall (Collette and Nauen 1983). King mackerel have been reported to migrate along the western Atlantic coast in large schools; however, there appears to be a resident population in south Florida as this species is available to sport fishers year round (Collette and Nauen 1983). Although the little tunny is epipelagic, it typically inhabits inshore waters in schools of similar size fish and/or with other scombrids (Collette and Nauen 1983). The diet of these scombrids consists of primarily fishes and to a lesser extent penaeid shrimp and cephalopods. The fishes that make up the bulk of their diet are small schooling clupeids (e.g., menhaden, alewives, thread herring, anchovies), atherinids, and to a lesser extent jack mackerels, snappers, grunts, and half beaks (Collette and Nauen 1983). The king and Spanish mackerel are important both commercially and recreationally. The king mackerel is a valued sport fish year round in Florida while the sport fisheries for Spanish mackerel in southern Florida is concentrated in the winter months. The cero is a valued sport fish that is taken primarily by trolling. The little tunny is not of commercial or recreational interest.

3.2.5 Summary of Impacts to the Coastal Migratory Pelagics Complex Fishes

The project area includes sand bottom, sand-veneered hardbottom, hardbottom, and water column that may be used by these managed fishes and their prey. Some possible refuge and related prey may be lost in regards to the impact to the hardbottom and sand areas; however, additional refuge would be created by the construction of an acre artificial reef to serve as replacement habitat. The project would cause localized turbidity during construction; however, turbidity would be minimized using the best management practices so that any impacts would be minor and temporary. These fishes and possible prey would be temporarily displaced, but should quickly return to the project area.

3.3 Associated Species

Associated species consists of living resources that occur in conjunction with the managed species discussed earlier. These living resources would include the primary prey species and other fauna that occupy similar habitats.

3.3.1 Invertebrates

Dredging and blasting associated with widening and deepening would result in direct adverse effects on invertebrate species in the area. Initially this would result in a significant, but localized reduction in the abundance, diversity, and biomass of the immediate fauna. Species affected most are those that have limited capabilities or are incapable in avoiding the dredging activities due to a sedentary lifestyle. The fauna most affected would include predominantly invertebrates such as crustaceans, echinoderms, mollusks, and annelids. However, due to the relatively small area that would be impacted as viewed on a spatial scale, impacts to the benthic community would be minimal due to the relatively short period of recovery following dredging activities (Culter and Mahadevan 1982; Saloman et al. 1982). Adjacent areas not impacted would most likely be the primary source of recruitment to the impacted area.

Zooplankton are primarily filter feeders and suspended inorganic particles can foul the fine structures associated with the feeding appendages. Zooplankton that feed by ciliary action (e.g., echinoderm larvae) would also be susceptible to mechanical affects of suspended particles (Sullivan and Hancock 1977). Zooplankton mortality is assumed from the physical trauma associated with dredging activities (Reine and Clark 1998). The overall impact on the zooplankton community should be minimal due to the limited extent and transient nature of the sediment plume.

3.3.2 Fishes

The larvae of the managed fish species discussed in this document are hatched from planktonic eggs (excluding the gray triggerfish) and the larvae are also planktonic. The primary source of larval food is microzooplankton with a dietary overlap in many species and specialization (Sale 1991). Algae are most likely food for only the youngest larval stages of certain species or for those larvae that are very small after hatching, and then only for a short time. The algae-eating larvae eventually switch to animal food while they are still small. At this time, varying life history stages of copepods become the dominant food and to a lesser extent cladocerans, tunicate and gastropod larvae, isopods, amphipods, and other crustacea.

Larval feeding efficiency depends on many factors such as light intensity, temperature, prey evasiveness, food density, larva experience, and olfaction (Gerking 1994). Larval fishes are visual feeders that depend on adequate light levels in the water column which reduces the reaction distance between larval fish and prey. Suspended sediment and dispersion due to dredging activities would increase turbidity levels in the project area temporarily. This would reduce light levels within the water column, which may have a short-term negative effect on feeding efficiency. In addition, turbidity can affect light scattering, which would impede fish predation (Benfield and Minello 1996). However, because the sediment plumes are transient and temporary, and the area to be impacted is relatively small when examined on a spatial scale, the overall impact to the larval fish population and consequently, the adult population should be minimal (Sale 1991). The majority of larval fish mortality would be attributed to the physical trauma associated with the dredging activities.

Similar to larval fishes, both juvenile and adult fishes are primarily visual feeders. Consequently, the visual effects of turbidity as outlined above will apply. Also, suspended sediment can impair feeding ability by clogging the interraker space of the gill raker or the mucous layer of filter feeding species

(Gerking 1994). However, because these fishes have the ability to migrate away from the dredging activities, the impact of the sediment plumes that are transient and temporary should be minimal. Although few adult fishes have been entrained by dredging operations (McGraw and Armstrong 1988; Reine and Clark 1998), most juvenile and adult fishes again have the ability to migrate away from the dredging activities. Consequently, dredging operations would have minimal effects on juvenile and adult fishes in the area. In addition, the reduction of benthic epifaunal and infaunal prey, and pelagic prey in the immediate area would have little affect on juvenile and adult fishes because they can migrate to adjacent areas that have not been impacted to feed.

In addition to the managed fish species discussed in this document, many other inshore and pelagic fishes in various stages of life occur in the project area (Gilmore 1977; Vare 1991; Lindeman and Snyder 1999). A total of 192 species have been recorded in association with nearshore hardbottom habitats in southeast Florida (Lindeman and Snyder 1999). In the study conducted by Lindeman and Snyder (1999), 80 percent of the fishes collected at all sites were early life stages. In addition, eight of the top ten fish species were consistently represented by early life stages, and the use of hardbottom habitats was recorded for newly settled stages of more than 20 species of fishes. This provided evidence that suggested that these nearshore hardbottom habitats along the mainland coast of east Florida may serve as nursery grounds for a wide diversity of juvenile reef fishes. Lindeman and Snyder (1999) estimated that 34 species of fishes used nearshore hardbottom habitats as a nursery. These nearshore hardbottom habitats may actually serve several nursery-related roles such as, 1) a centrally located refuge for incoming early life stages that would exhibit considerably greater mortality if shelter were not available, 2) habitat for juvenile fishes (e.g., gray snapper, blue stripe grunt) that emigrate out of inlets to offshore waters, and 3) an area to promote growth because of the greater availability of prey at these hardbottom habitats.

3.3.3 Summary of Impacts to Associated Species

Many of the fishes associated with nearshore hardbottom habitats as observed in past studies (Gilmore 1977; Vare 1991; Lindeman and Snyder 1999), would be common along Miami-Miami-Dade County. The majority of juvenile and adult fishes would be displaced to adjacent habitat during dredging operations; consequently, mortality of these fishes should be minimal. Only those species that produce demersal eggs and that comprise the demersal ichthyofauna could potentially be impacted more heavily than their pelagic counterparts. Mortality of demersal eggs and larvae would be expected from the physical trauma associated with dredging operations. Suspended sediments produced by these operations can affect the feeding activity of pelagics as outlined earlier; however, the impact to these fishes should be minimal due to the limited extent and transient nature of the sediment plume.

4.0 CONCLUSIONS

The proposed project would impact seagrass, hardbottom/reef, algae, and water column. Construction of a mitigation reef and restoration of seagrass habitat may create high quality nearshore hardbottom and seagrass habitat similar to what is currently available within the study area. Significant adverse impacts to those species associated with EFH within the project area are not expected.

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